SUMMARY OF Ph.D. DISSERTATION

School	Student Identification Number	SURNAME, First name KUROKAWA, Haruki

Title

Syntheses of goethite particles via aqueous solution routes

Abstract

Morphological control of goethite particles by various operation conditions in a bench scale was devised in an attempt to improve magnetic properties of the end products, i.e. maghemite or magnetite. Reaction parameters systematically varied were among others alkaline sources, degree of off-equivalence by neutralization, oxidation aeration and aging. Detailed crystallographical analyses based on X-ray diffractometry and electron micrographs were employed as principal analytical tools.

When ferrous sulfate and sodium hydroxide were used, precursors immediately before goethite were $Fe(OH)_2$ or Green rust (II), at excess or deficiency of alkali, respectively. Neutralized by ferrous carbonate, in contrast, mixture of $FeCO_3$ and $Fe(OH)_2$. The latter precursor turned out to be by far superior in view of smaller acicular particles with higher aspect ratio. The superiority is mainly attributed to adequate lateral growth along (110) as compared to the growth rate in (010) direction. Preferential lateral growth, in turn, was predominated by the concentration of FeOH+ complex ions and buffer action of Fe2+ ions.

This makes contrast to the cases by starting from Fe(OH)2 or Green rust (II), where the preferential growth was not particularly distinctive. These preferences are valid under alkali excess conditions. As for the aeration oxidation from ferrous to ferric state of iron being rate determining in the entire goethite synthesis, disintegration of air bubbles plays another important role for efficient oxidation at the air / solution interface.

From the viewpoint of application to high-density magnetic recording, after transformation to maghemite or magnetite, high coersive force and high density packing after filming are of utmost importance. Since morphology of those magnetic materials is sustained from those of goethite, it is safe to conclude that proper choice of the starting ferrous source, extent of alkali excess and concentration of dissolved oxygen are the key factors for better goethite particles and, hence, better materials for magnetic recording..